

# Designing Navigation and Coastal Infrastructure for Greater Environmental Sustainability: An Overview of Projects

**Cynthia J. Banks**

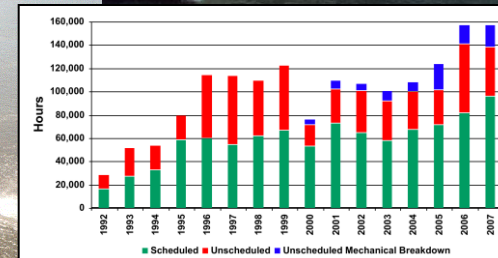
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Symposium

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US Army Corps of Engineers  
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# Outline

- USACE Policy
- *Engineering With Nature* (EWN) definition and essential ingredients
- EWN projects
- Path Forward
- Acknowledgments

# The USACE Navigation Mission

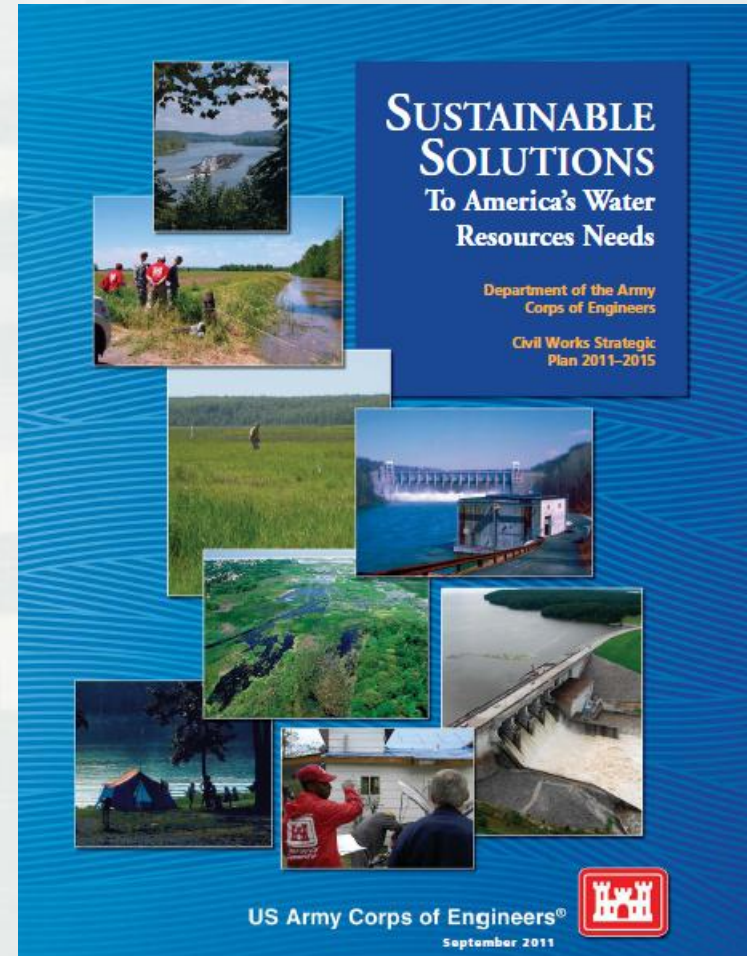
To provide safe, reliable, efficient, effective and **environmentally sustainable** waterborne transportation systems for movement of commerce, national security needs, and recreation



# The USACE Civil Works Strategic Plan

## *Sustainable Solutions to America's Water Resources Needs*

- Vision: “Contribute to the strength of the Nation through innovative and **environmentally sustainable** solutions to the Nation's water resources challenges.”
- The goals established by this strategy are to:
  - ▶ Assist in providing for safe and resilient communities and infrastructure.
  - ▶ Help facilitate commercial navigation in an environmentally and economically sustainable fashion.
  - ▶ Restore degraded aquatic ecosystems and prevent future environmental losses.
  - ▶ Implement effective, reliable, and adaptive life-cycle performance management of infrastructure.
  - ▶ Build and sustain a high quality, highly dedicated workforce.



# The USACE Campaign Plan


Goal 1. Deliver USACE support to combat, stability, and disaster operations through forward deployed and reach back capabilities

Goal 2. Deliver enduring and essential water resource solutions through collaboration with partners and stakeholders

Goal 3. Deliver innovative, resilient, sustainable solutions to the armed forces and the Nation

Goal 4. Build and cultivate a competent, disciplined, and resilient team, equipped to deliver high quality solutions

**Goal 2:** Deliver enduring and essential water resource solutions through collaboration with partners and stakeholders.

**Objective 2a:** Deliver integrated, sustainable, water resources solutions. 

**Objective 2b:** Implement collaborative approaches to effectively solve water resource problems.

**Objective 2c:** Implement Streamlined and Transparent Regulatory Processes to Sustain Aquatic Resources.

# The USACE Environmental Operating Principles



US Army Corps  
of Engineers®

## **ENVIRONMENTAL OPERATING PRINCIPLES**

*One Corps Serving The Army and the Nation*

Further information is available at: <http://www.usace.army.mil>



*Environmental  
Sustainable Housing  
Fort Lee, VA*



*Endangered Whooping Crane  
Aransas National Wildlife Refuge, Texas*

1

Strive to achieve Environmental Sustainability. An environment maintained in a healthy, diverse, and sustainable condition is necessary to support life.

2

Recognize the interdependence of life and the physical environment. Proactively consider environmental consequences of Corps programs and act accordingly in all appropriate circumstances.

3

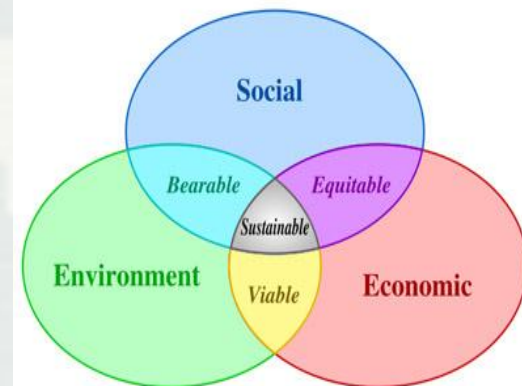
Seek balance and synergy among human development activities and natural systems by designing economic and environmental solutions that support and reinforce one another.

Continue to accept corporate responsibility and accountability under the law for activities and decisions under our control that impact human health and welfare and the continued viability of natural systems.



# Definition

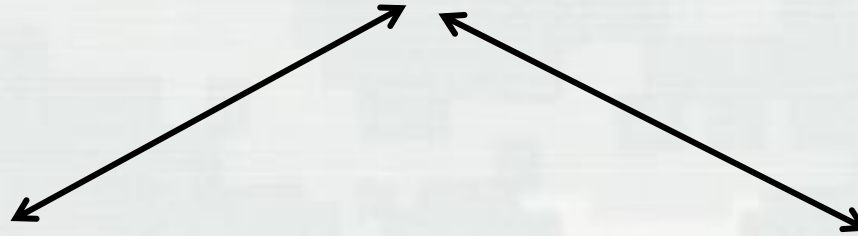
- *Engineering With Nature* is the intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental and social benefits through collaborative processes.







***Working  
with Nature***



***Building  
with Nature***



***Engineering  
With Nature***



# **The Essential Ingredients of *Engineering With Nature***

- Use science and engineering to produce operational efficiencies
  - ▶ Contributing to sustainable delivery of project benefits
- Use of natural processes to maximum benefit
  - ▶ To reduce demands on limited resources, minimize the environmental footprint of the project, and enhance the quality of benefits produced
- Broaden and extend the base of benefits provided by projects
  - ▶ To include substantiated economic, social and environmental benefits
- Use science-based collaborative processes to organize and focus interests, stakeholders and partners
  - ▶ To reduce social friction, resistance and project delays while producing more broadly acceptable projects

# ***Engineering With Nature***

## **Project Overview**

# Environmental Enhancement and Navigation Infrastructure (EENI)

- To increase application of environmental sustainability to the design and maintenance activities associated with navigation infrastructure
  - ▶ Webinars
  - ▶ On-line Survey
  - ▶ Telephone Follow-up
  - ▶ Meeting/Conference Presentations
  - ▶ Data Summary
  - ▶ Report



*Dredging Operations and  
Environmental Research*



# ***Engineering With Nature***

## **Example**



**Photograph 2.12.** A Series of Chevrons on the Mississippi River



**Photograph 2.13.** A Series of Chevrons Aligned To Split Flow Between the Main Channel and a Side Channel, While Protecting the Existing Shoreline

**Upper Mississippi River Training Structures**  
(Photos courtesy of USACE Rock Island District)

# EENI Products

ERDC/EL TR-11-7

Environmental Laboratory



US Army Corps  
of Engineers®  
Engineer Research and  
Development Center

## Environmental Enhancements and Navigation Infrastructure: A Study of Existing Practices, Innovative Ideas, Impediments, and Research Needs

Thomas J. Fredette, Christy M. Foran, Sandra M. Brasfield,  
and Burton C. Suedel

July 2011



## Environmental Enhancements and Navigation Infrastructure: Existing Practices, Innovative Ideas, and Research Needs

by Thomas J. Fredette, Christy M. Foran, Sandra M. Brasfield,  
and Burton C. Suedel

ERDC TN-DOER-R16  
June 2011

**PURPOSE:** The concept that navigation infrastructure can serve as valuable habitat is not novel. However, the concept of designing navigation infrastructure with the specific intent of accomplishing both the engineering goal and specific environmental goals is, in most instances, a new idea for many planners and designers. The inclusion of environmental enhancements in navigation infrastructure represents both opportunities and challenges for project managers. The purpose of this document is to present an overview of the advantages, while addressing some of the implementation challenges, as seen by the current planning and engineering contingents. This study sought to (1) identify existing and potential navigation project features that were designed with the express intent of enhancing environmental benefit, (2) identify laws, regulations, and policies (formulation boundaries) that both support and hinder such design features; (3) identify opportunities for increasing environmental benefits for navigation projects within existing formulation boundaries; (4) propose potential changes to formulation boundaries that would further increase opportunities for environmental benefits; and (5) identify potential areas where research may increase the opportunity to integrate environmental features into future projects.



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## Environmental Engineering of Navigation Infrastructure: A Survey of Existing Practices, Challenges, and Potential Opportunities

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### ABSTRACT

Navigation infrastructure such as channels, jetties, river training structures, and lock and dam facilities are primary components of a safe and efficient water transportation system. Planning for such infrastructure has until recently involved efforts to minimize impacts on the environment through a standardized environmental assessment process. More recently, consistent with environmental sustainability concepts, planners have begun to consider how such projects can also be constructed with environmental enhancements. This study examined the existing institutional conditions within the US Army Corps of Engineers and cooperating federal agencies relative to incorporating environmental enhancements into navigation infrastructure projects. The study sought to (1) investigate institutional attitudes towards the environmental enhancement of navigation infrastructure (EENI) concept, (2) identify potential impediments to implementation and solutions to such impediments, (3) identify existing navigation projects designed with the express intent of enhancing environmental benefit in addition to the primary project purpose, (4) identify innovative ideas for increasing environmental benefits for navigation projects, (5) identify needs for additional technical information or research, and (6) identify laws, regulations, and policies that both support and hinder such design features. The principal investigation tool was an Internet-based survey with 53 questions. The survey captured a wide range of perspectives on the EENI concept including ideas, concerns, research needs, and relevant laws and policies. Study recommendations included further promotion of the concept of EENI to planners and designers, initiation of pilot studies on some of the innovative ideas provided through the survey, and interagency agreements to facilitate implementation. Integr Environ Assess Manag

Jetties Breakwaters Sustainability Lock and dam

The US Army Corps of Engineers (USACE) has responsibility for an extensive coastal, intracoastal, and inland navigation system with over 19 000 km of navigation channel, 195 navigation locks, and hundreds of jetties, breakwaters, and anchorages. For example, the New England District alone has over 130 breakwaters and jetties with a total length of over 60 km, over 800 hectares of anchorage, and over 750 km of channel. In addition to maintenance and replacement of existing structures, the USACE is also tasked with building new infrastructure on an ongoing basis. As a consequence, applying an environmental sustainability paradigm during the planning for new infrastructure or maintenance of existing infrastructure could result in substantial benefits for ecosystem services where the concept is applied. It is also important to recognize, however, that the USACE is a very large organization and that its activities are governed by a complex set of environmental and fiscal laws, regulations, and policies. Paradigm shifts must contend with such realities. Accordingly, this study was designed to examine the existing institutional conditions within the USACE and cooperating federal agencies relative to incorporating environmental enhancements into navigation infrastructure projects. The study sought to (1) investigate institutional attitudes towards the environmental enhancement of navigation infrastructure (EENI) concept, (2) identify potential impediments to implementation and solutions to such impediments, (3) identify existing navigation projects designed with the express

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Environmental Policy & Regulation

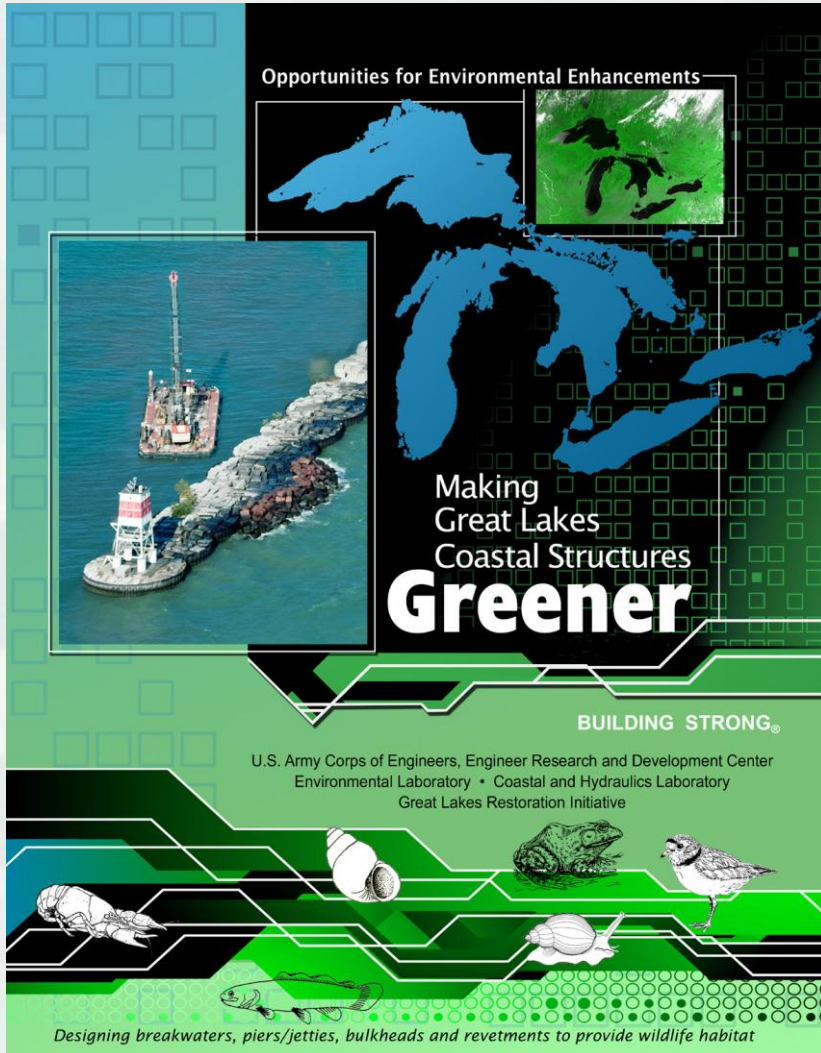
# **USEPA Great Lakes Restoration Initiative (GLRI) Breakwater Ecosystem Improvement Study**

- To evaluate opportunities for enhancing aquatic ecosystem benefits at existing breakwaters and navigation structures
- During routine repairs and maintenance, as part of modifications, or during comprehensive structural repairs and replacements
- Concept extends to shore protection structures, non-USACE structures





# GLRI Products





# Cleveland Harbor Pilot Project

- Cleveland Harbor East Arrowhead Breakwater was identified as a coastal structure with critical repair needs located in an Area Of Concern (Cuyahoga River)
- The project involves:
  - ▶ Providing features that will create habitat opportunities for Great Lakes fish and invertebrates
  - ▶ Modifying the design (shape and surface texture) of the standard concrete toe blocks used for breakwater maintenance
    - Dimpled surface texture
    - Horizontal line surface texture
    - Protected indented shelf (horizontal line)
    - No alterations (control)

# Modified Breakwater Toe Blocks



The left photo shows a dimpled block surface. The right photo shows a horizontal line block surface. A fish habitat shelf with a horizontal line texture is shown bottom center.

# **EWN Concept Promotion**

- Conferences – 8
- Meetings – 8
- Webinars – 7
- Workshops – 4
- Technical Documents – 3
- Brochures/Magazine Articles – 2

**Total = 32**

# ***Engineering With Nature Path Forward***

We will implement *Engineering With Nature* through a series of actions:

1. Establish the foundation of EWN using examples of “best-practice” projects from across USACE
2. Develop and execute a “Strategic Plan for EWN” to expand application within USACE and with our external partners and stakeholders
3. Demonstrate the EWN progression in future project case studies, communicating lessons learned and successes broadly
4. Focus R&D investments to expand technical and communication science needed to advance EWN
5. Establish leadership and partnerships on EWN through effective engagement and application



# Acknowledgements

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